

Out of the Fog

Humboldt Bay

Mark Meade, PE, PLS, CP
Senior Vice President

Presentation Outline

- Project Information
- Aerial Imagery Acquisition
- Tide Planning
- Habitat Classifications
- Uses of the Data
- Awards and Recognition

Project Information

- Humboldt Bay lies along the pacific coast of California, about 250 miles north of San Francisco
- Second largest estuary in California
- Only deepwater port in the 400 miles of shoreline stretching from SF Bay to Coos Bay
- Very valuable commercial, recreational, and cultural resources



Humboldt Bay

San Francisco Bay

©2011 Google - Imagery ©2011 TerraMetrics, NASA, Map data ©2011 Europa Technologies, Google - Terms of Use

Importance of Humboldt Bay

- Contains more than 100 species of fish
- Hosts the largest commercial oyster production operation in the state, accounting for 60% of the state's annual production
- Prior to this project, the last habitat inventory for the Bay was conducted between 1970-1980
- Few studies of any kind had been conducted on the Eel River

Planning for New Aerial Imagery

- Flight planned for 20,000 feet above ground to produce a 0.5 meter GSD from a 4-band digital framing sensor (R, G, B, NIR)
- Need for very low tides (-1.0 feet and below) to expose intertidal habitat & peak biomass
- Sun angle between 25 and 40 degrees to minimize shadows and eliminate sun glint
- Additional requirements based on clear skies, low wind speeds, no recent rainfall events...

Planning for New Aerial Imagery

- Tide requirements resulted in only approximately 15 potential flight days per year
- Based on a combination of tide stage and sun angle requirements
- Opportunities occurred in the morning hours (the afternoon lows were considerably higher than morning lows) when the northern California coast is dominated by fog and clouds

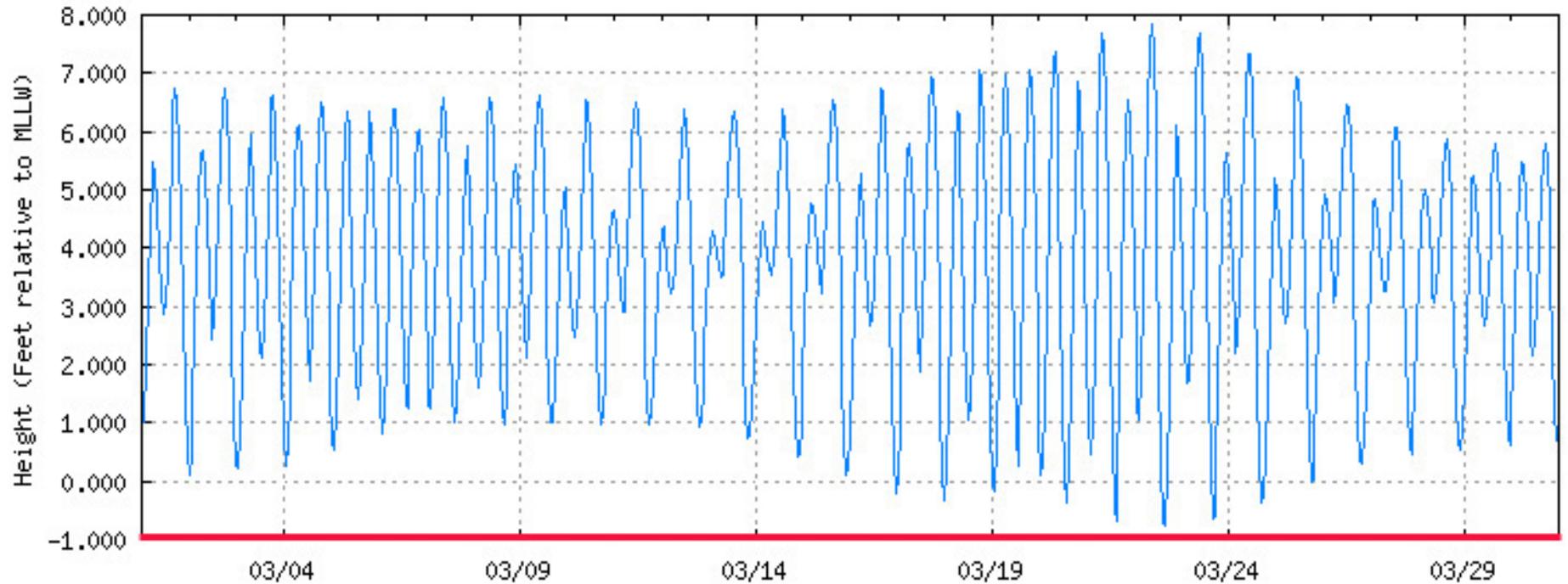


Challenges to Imagery Acquisition

- Pacific Ocean has mixed tides, with the lowest low typically occurring in the early morning
- Complicating matters, you have prevailing winds from the northwest sweeping over the cool ocean (typically 47 to 55 degree waters)
- Result is fog and low clouds that don't burn off until mid day, after the low has typically occurred



NOAA/NOS/CO-OPS
Predicted Water Level Plot
9418767 North Spit, Humboldt Bay, CA
from 2011/03/01 - 2011/03/30



New Moon

1st Quarter

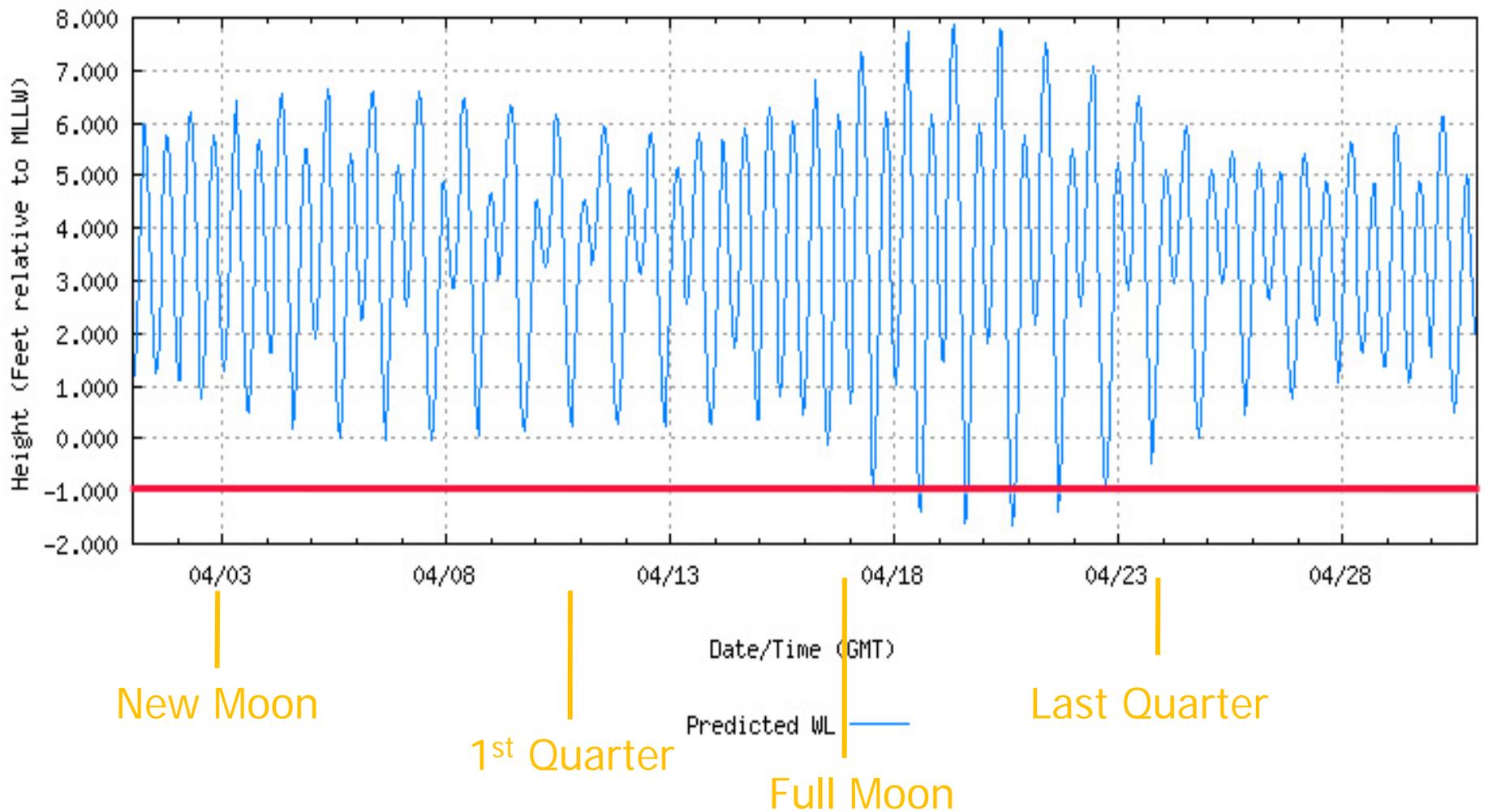
Full Moon

Last Quarter

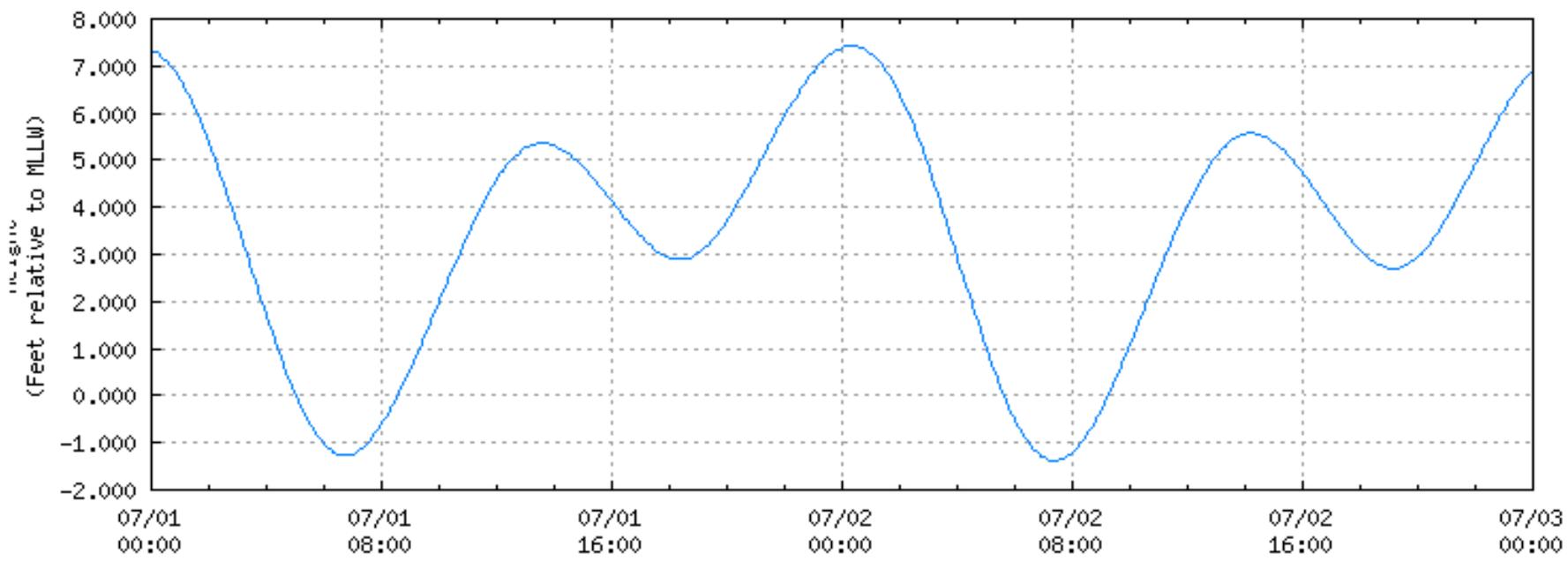
Date/Time (GMT)

Predicted WL

NOAA/NOS/CO-OPS
Predicted Water Level Plot
9418767 North Spit, Humboldt Bay, CA
from 2011/04/01 - 2011/04/30

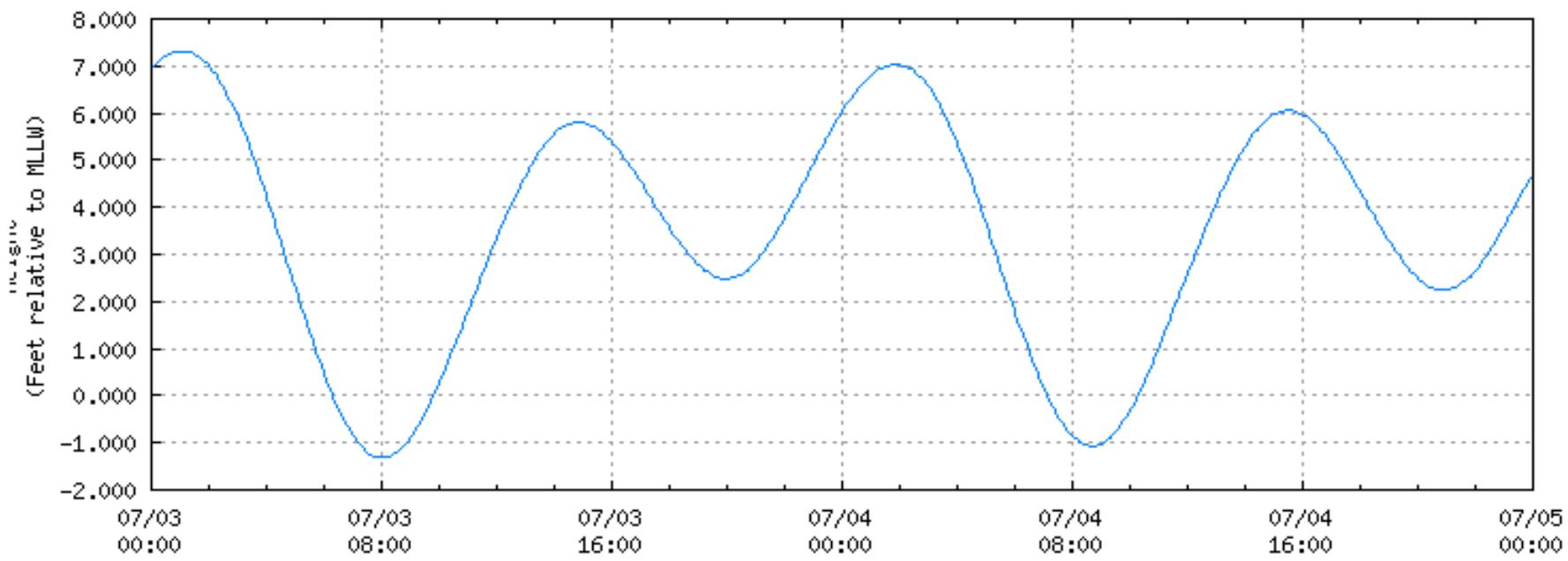


NOAA/NOS/CO-OPS
Preliminary Water Level (A1) vs. Predicted Plot
9418767 North Spit, Humboldt Bay, CA
from 2011/07/01 - 2011/07/02



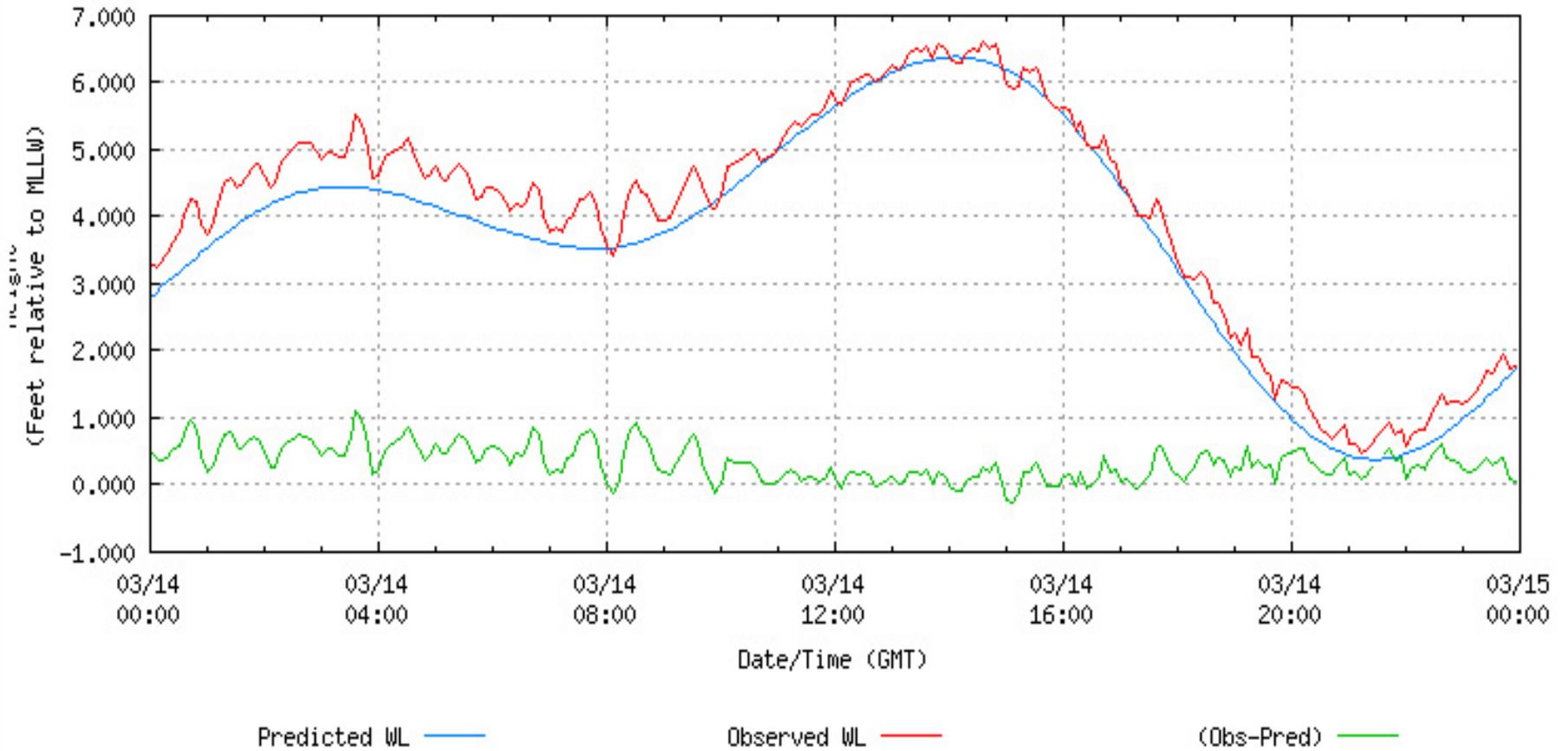
Predicted WL ——— Observed WL ——— (Obs-Pred) ———

NOAA/NOS/CO-OPS
Preliminary Water Level (A1) vs. Predicted Plot
9418767 North Spit, Humboldt Bay, CA
from 2011/07/03 - 2011/07/04



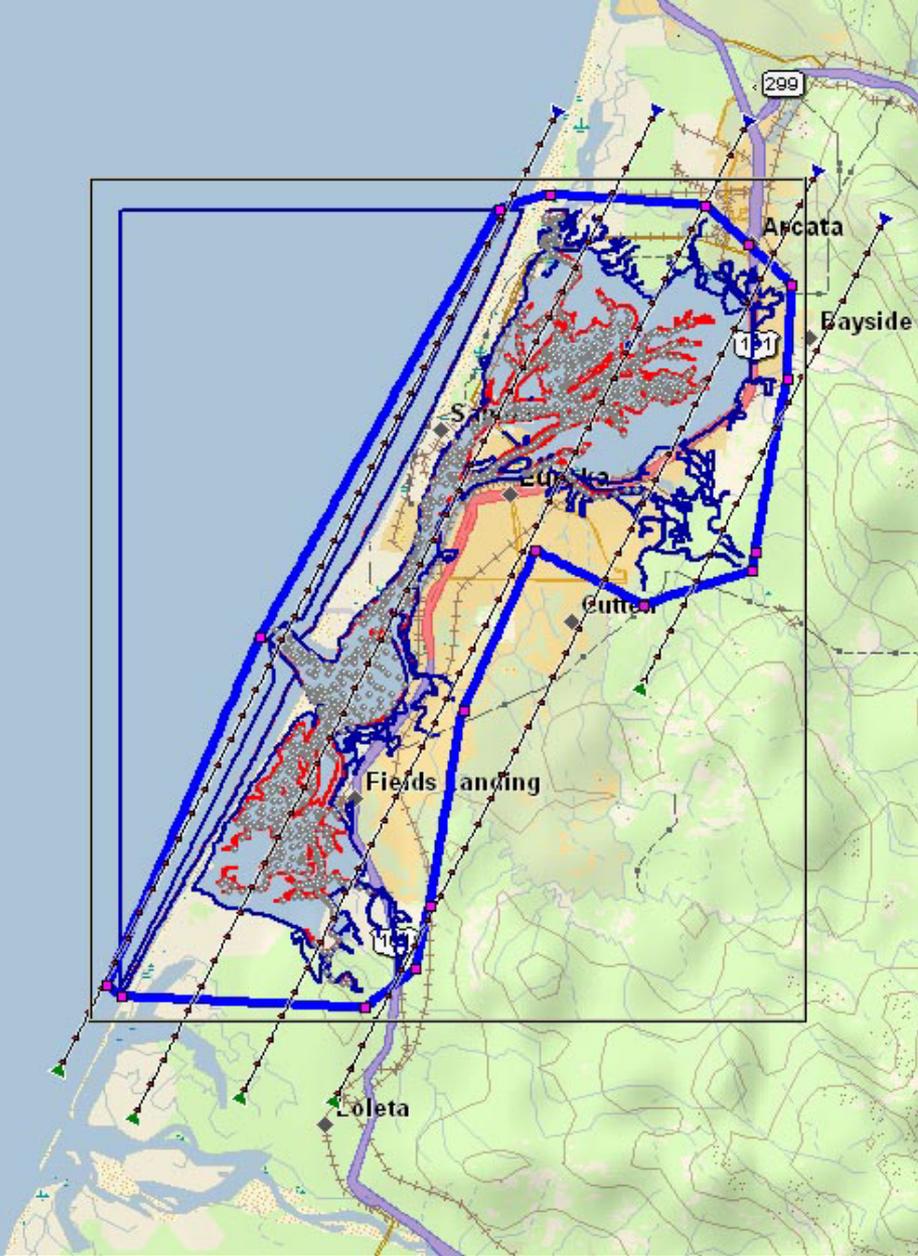
Predicted WL — (blue line) Observed WL — (red line) (Obs-Pred) — (green line)

NOAA/NOS/CO-OPS
Preliminary Water Level (A1) vs. Predicted Plot
9418767 North Spit, Humboldt Bay, CA
from 2011/03/14 - 2011/03/14



Aerial Photography

- After 3 years, finally had the right combination of a high pressure system sitting over the Bay, light offshore winds, right lunar conditions
- Imagery captured by HJW Geospatial (Oakland, California) with a Vexcel UltraCam sensor
- Consisted of 4 flight lines and 135 frames covering the project area
- Flown morning of June 27, 2009





Arcata, CA

Arcata Bay



Tide Planning

- Developed a geospatial model for each imagery frame along individual flight lines
- Used the NWLON tide gauge at North Spit (in the Bay) to do water level predictions
- Manual method of tide planning required about 2 hours to complete and check
- Planning for each day had to be completed individually as the sun angle and tides move from day-to-day

Tide Planning (continued)

- Realized a significant amount of effort could be saved with an automated solution
- Software carefully designed to ensure that it could be used on all other tide coordinated projects undertaken by the firm
- Software brings together tide information (predicted and real time tides from NOAA CO-OPS), solar altitude (US Naval Observatory), and current and predicted weather (NOAA NWS)

57°F 46°F Wind: mph @ 100% Rain, 100% Cloud Cover Solar Window: 12:46-17:14	55°F 46°F Wind: mph @ 33% Rain, 49% Cloud Cover Solar Window: 12:49-17:12	57°F 44°F Wind: mph @ 5% Rain, 37% Cloud Cover Solar Window: 12:51-17:10	57°F 44°F Wind: mph @ 0% Rain, 49% Cloud Cover Solar Window: 12:53-17:08	58°F 48°F Wind: mph @ 3% Rain, 34% Cloud Cover Solar Window: 12:56-17:06
--	--	---	---	---

Project Humboldt Bay Display Tide Profile Display Graph

Settings

Time Zone: PST GMT +/- -8 **Projection Date:** 11/ 9/2010 Today +1 Day

Target: MHW **Units:** m

Tolerance about target: Above 0.30 m Below 0.30 m **Time Buffer:** 0 minutes

Solar Window: Start 12:46 End 17:14 **Get From Position:** Lat (dec) 40.76667 Sun Angle 25 degrees **Get Solar Window:** Auto-Fill

Weather

Tide Stations

Station Name	Station ID	Height Corrector	Time Corrector
North Spit, Humboldt Bay, CA	9418767	0.00 m	-5 mins
Crescent City, CA	9419750	0.30 m	0 mins

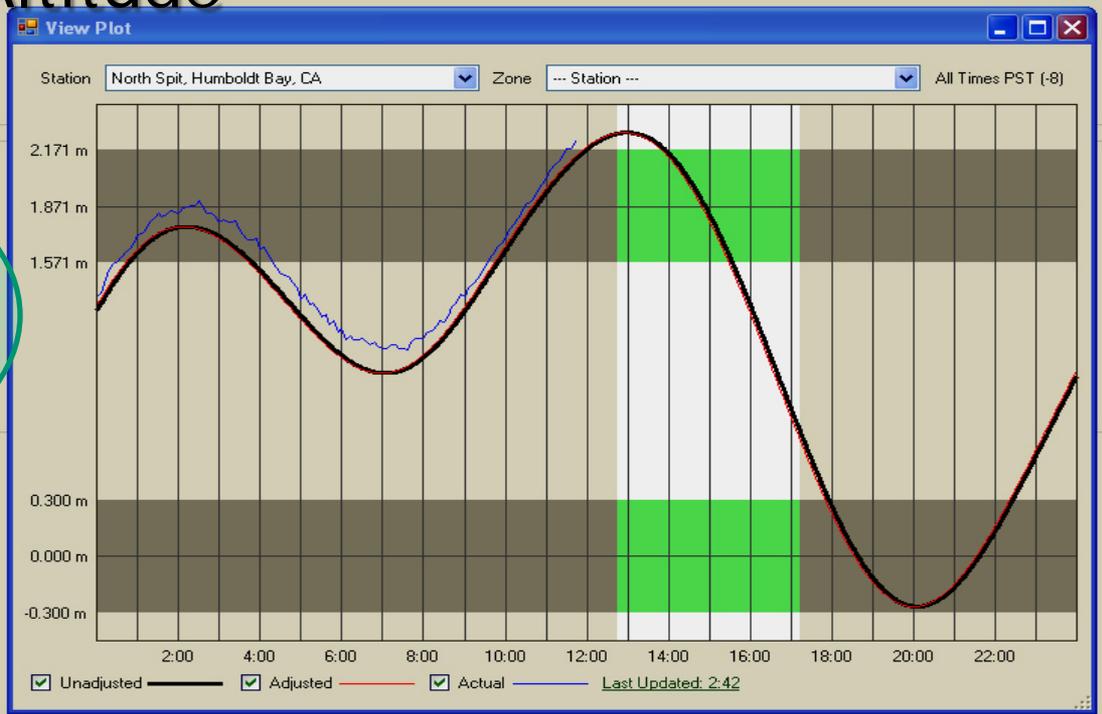
Solar Altitude

Planning

Flight Line	Start Frame	End Frame	Valid Times
<input checked="" type="checkbox"/> 1	1	3	13:56 - 15:29
<input checked="" type="checkbox"/> 2	1	2	14:40 - 15:52
<input checked="" type="checkbox"/> 3	1	6	14:40 - 15:52
<input checked="" type="checkbox"/> 4	1	8	14:40 - 15:52
<input checked="" type="checkbox"/> 5	1	8	13:57 - 15:29

[View Frame Ranges](#) [Export Ranges](#)

Flight Times



Habitat Classifications

- Minimum mapping unit of 0.01 hectares... nominally 10 meters x 10 meters
- Classifications included unconsolidated sediment, coastal marsh, oyster mariculture, eelgrass, patchy eelgrass, macroalgae, and subtidal
- Team visited the Bay to collect ground truth data to support photo interpretation



Oyster Mariculture

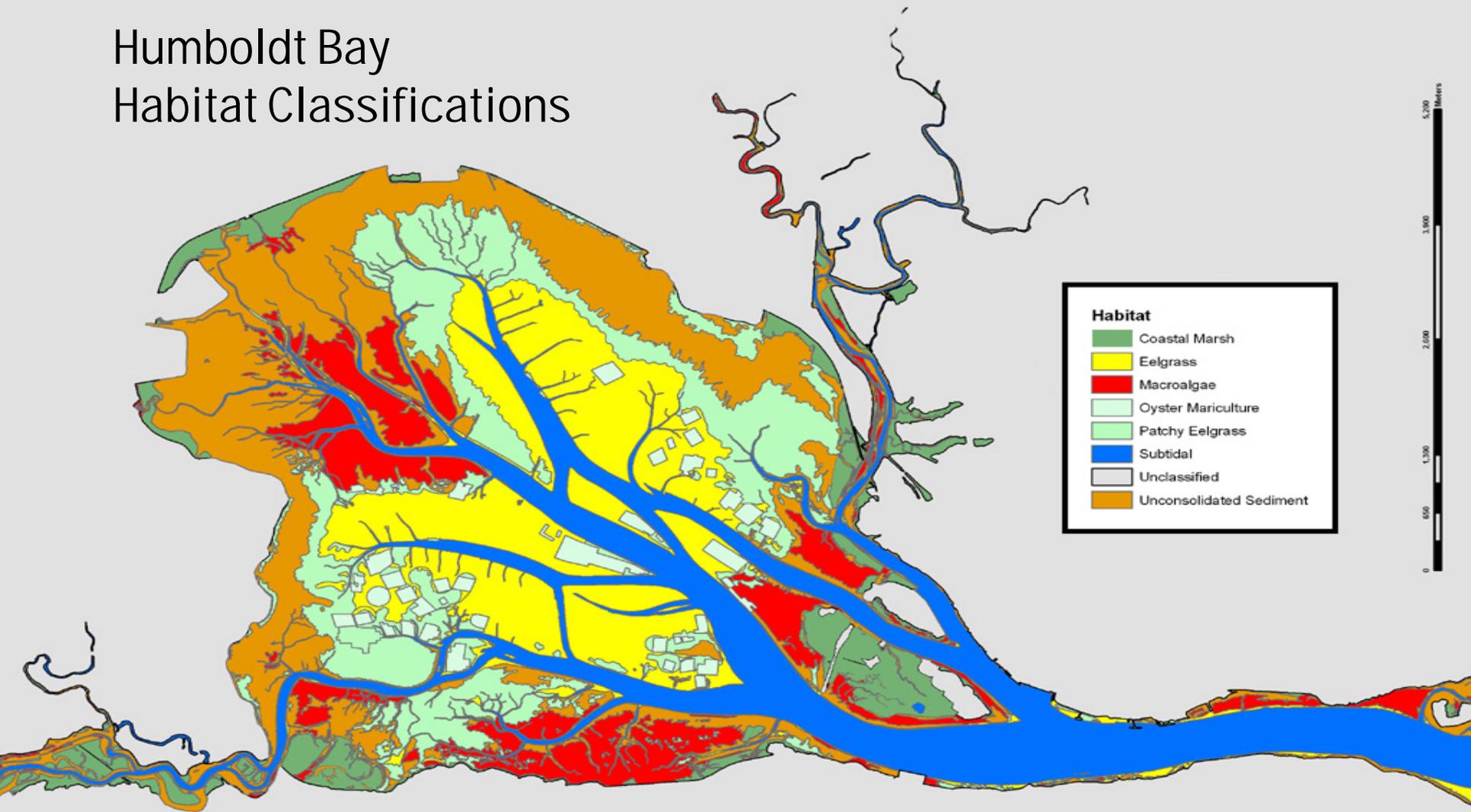


Leopard Skin Eelgrass

Algal Mat



Humboldt Bay Habitat Classifications



Use of Data

- Orthorectified images were made public in September 2009
- More than 20 businesses, municipal and county departments, state and federal agencies, and academics requested imagery during first month
- Subsequently 12 other users took delivery

Use of Data

- 75 percent of the original recipients requested the habitat classifications when they were complete
- In September 2010, the images, classification, metadata, and reports were made available on NOAA's Digital Coast
- www.csc.noaa.gov/digitalcoast/

Digital Coast - NOAA Coastal Services Center - Windows Explorer

http://www.csc.noaa.gov/digitalcoast/index.html

File Edit View Favorites Tools Help

Google Search

Digital Coast - NOAA Coastal Services Center

More than just data...

The Digital Coast also provides the tools, training, and information needed to turn these data into the information most needed by coastal resource management professionals. [Read more...](#)

Welcome to the Digital Coast. If you have questions or comments, please [take a video tour](#) or [contact us](#).

Data

Learn more about the kinds of data available and download data.

Tools

Use these tools to turn data into the useful information your organization needs.

Approaches

Coastal Inundation Toolkit

Understand the basics and get the tools that will help make your community more resilient.

Offshore Renewable Energy Planning

Get the data and tools needed to make

Featured Resources

Digital Coast Webinar Series

Features a series of presentations, demonstrations, and discussions on Digital Coast products.

State of the Coast

Get a state-level view of how coastal ecosystems, economies, and communities

Use of Data

- California Department of Fish and Game – natural resource management and restoration efforts
- USFWS – restoration planning, invasive cordgrass, NWI mapping
- Humboldt State University – various projects and thesis research
- California Coastal Conservancy and Sea Grant Program – invasive species mapping

Awards & Recognition

- MAPPS – Airborne and Satellite Data Acquisition... First Place Nationally, 2010
- ACEC-KY – Grand Conceptor Award, First Place in Statewide Competition, 2010
- Feature Article in the January 2011 Edition of Point of Beginning Magazine – co-authored by NOAA CSC, California Sea Grant, and Photo Science

Questions?